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//GAME DEVELOPMENT BASICS PART II

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Gamedev Basics

1. Part I
    1. Intro
    2. Frame
    3. Game Loop
    4. Ascii rendering
2. Part II
    1. **Clock**
    2. State Machine
3. Part III
    1. 1D array
    2. Collision Grid
    3. Code good Practices

The problem

```
#include "Console/Console.h"
#include <Windows.h>

static int bGameIsRunning = 1;
static int x = 0;

int main()
{
    // Game Initialization
    [Console initialization here]

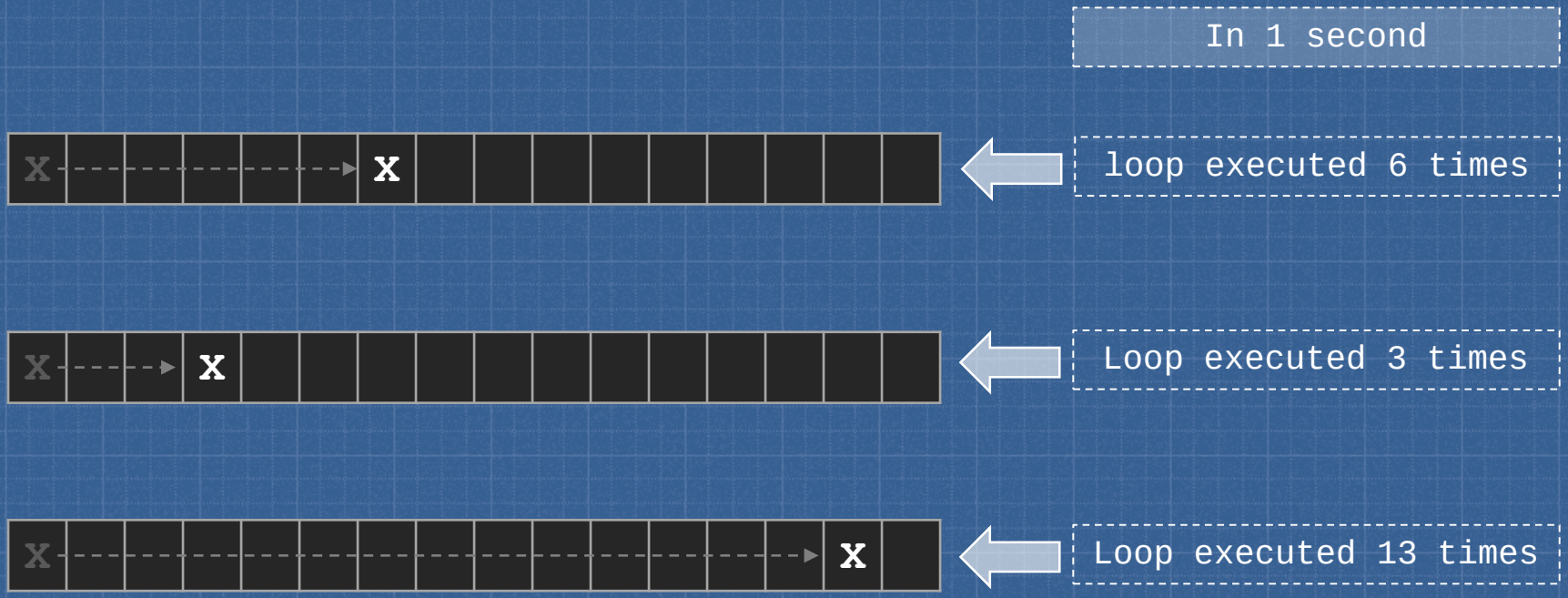
    // Game Loop
    while (bGameIsRunning)
    {
        // Process Inputs
        [Input processing here]

        // Update
        x = x + 1;

        // Render
        Console_Clear();
        Console_Putchar(x,0,'X');
    }
    // Game Shutdown
    [Clean shutdown here]
}
```

- Current Code :
  - modify X
  - +1, each Frame

Game Loop time calculation is variable



Depending on Computer Speed, or Execution path, your Game loop can run faster or slower

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How to fix it: Method 1

- Make sure the Game loop is always running at same speed
  - Insert artificial delay to keep it at X fps
  - “Frame locked”

FrameLocking

```
[includes here]
static int bGameIsRunning = 1;

int main()
{
    [Game initialization here]

    // Game Loop
    while (bGameIsRunning)
    {
        // Read Current Time at Frame Start
        double startTime = [GetCurrentTimeSeconds];

        [Input processing here]

        [Update here]

        [Render here]

        // Calculate the Time the Frame Took
        double frameTime = [GetCurrentTimeSeconds] - startTime;

        // Wait until 0.016666 sec elapsed for 60fps
        // Sleep is in Ms
        Sleep((0.016666 - frameTime)*1000);
    }

    [Game Shutdown here]
}
```

- We get the Start Time of a frame with a function
- We calculate the Duration of a Frame
- Sleep() the remaining of the 0.016666666…s to have a constant frame time

  (Or we do a Loop)

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How to fix it: Method 2

- Modify the movement calculation to use time
  - DeltaTime: Time Elapsed between 2 frames
  - Euler Method movement Calculation

Euler method

Position =

Old Position+Velocity*DeltaTime

$$X = X_{-1} + V * dT;$$

Euler Method for Movement

```
#include "Console/Console.h“
#include "Clock/Clock.h“
#include <math.h> // C Math library
#include <Windows.h>

static int bGameIsRunning = 1;
static double eulerX = 0.f;
static double velocity = 0.001f; // Units per ms

int main()
{
    // Game Initialization
    [Console initialization here]

    // Game Loop
    while (bGameIsRunning)
    {
        // Frame Time calculation, DeltaTime
        Clock_GameLoopStart();

        // Process Inputs
        [Input processing here]

        // Update
        eulerX = eulerX + velocity * Clock_GetDeltaTime();

        // Render
        Console_Clear();
        Console_Putchar((int)round(eulerX),0,’X‘);
    }
    // Game Shutdown
    [Clean shutdown here]
}
```

- DeltaTime: milliseconds
  - Use Clock.h
- Need to Define a Velocity
  - units per ms
- Need to round the decimal value to integer value

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    // Game Loop
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    {
        // Process Inputs
        [Input processing here]

        // Update
        [Update code here]

        // Render
        [Rendering code here]

}
    // Game Shutdown
    [Clean shutdown here]
}
```

- We want
  - A Start Menu
  - The Game
  - A Game Over
- We don't want
  - Spaghetti code with nested loops
  - All the code in the Game Loop

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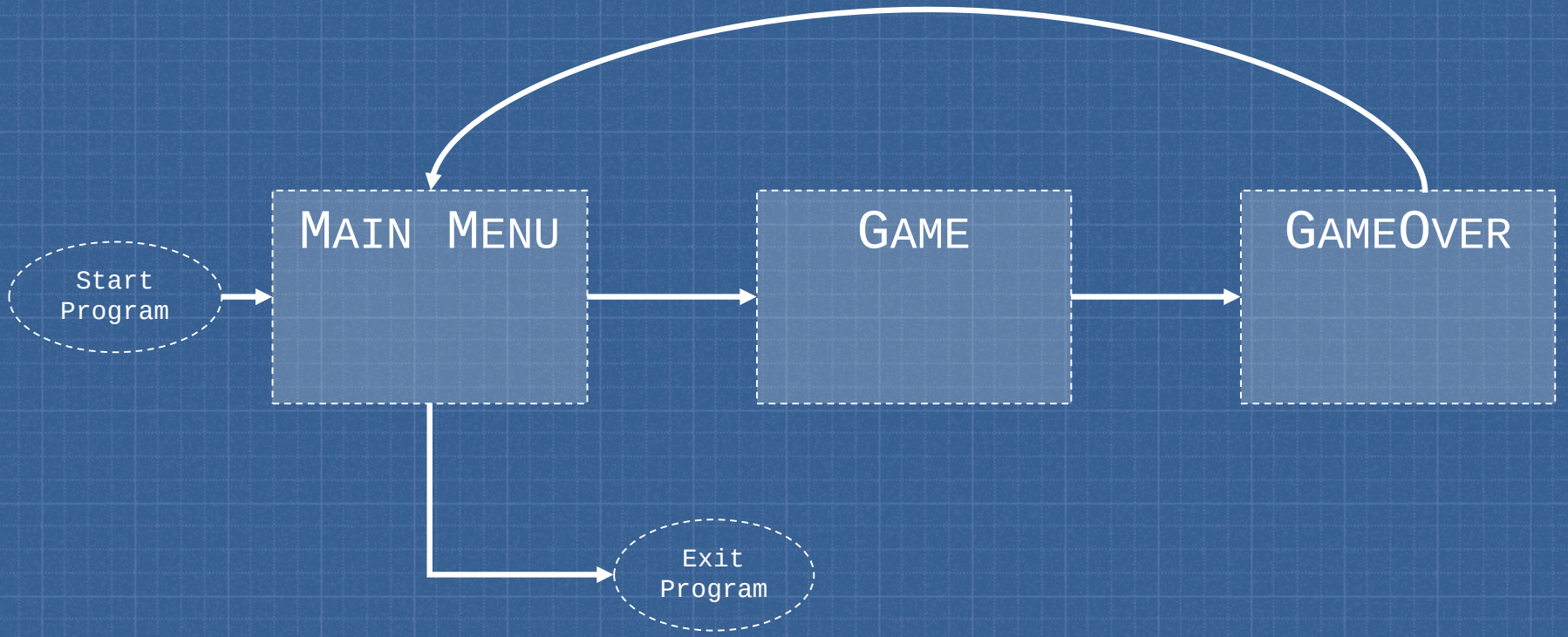
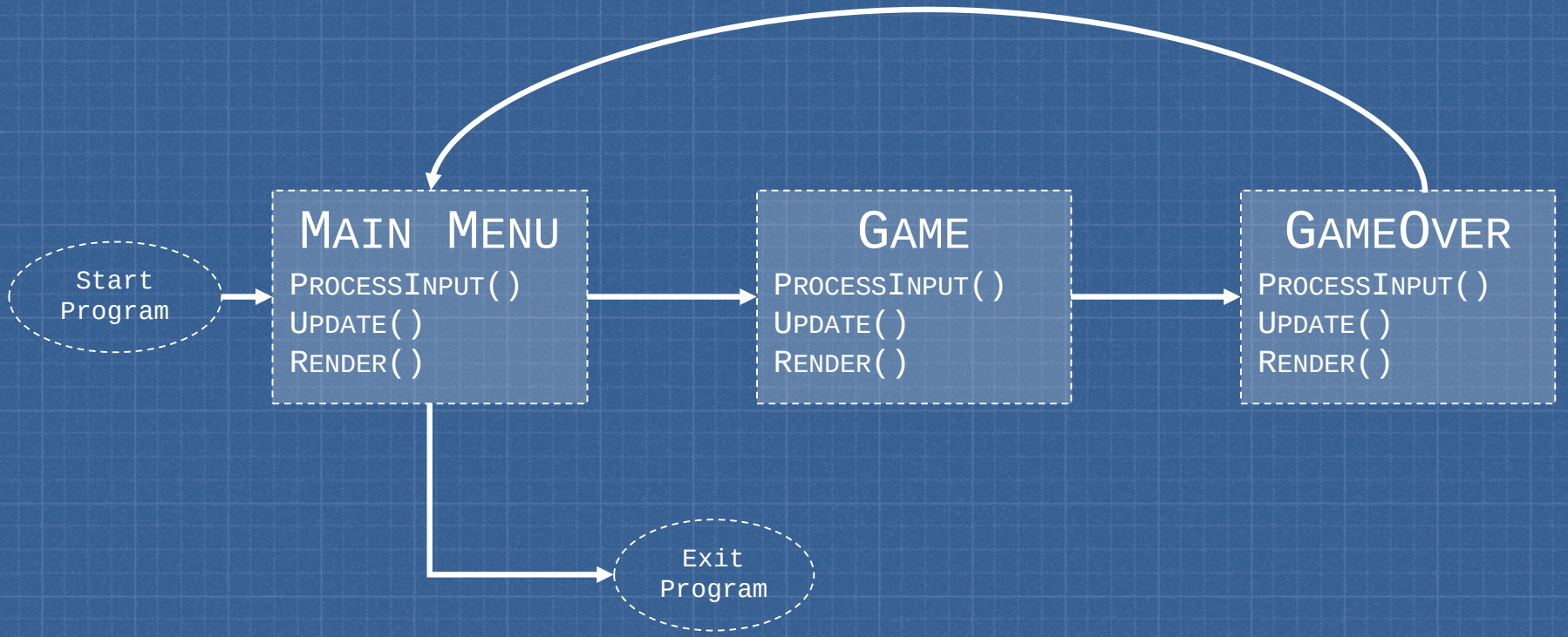
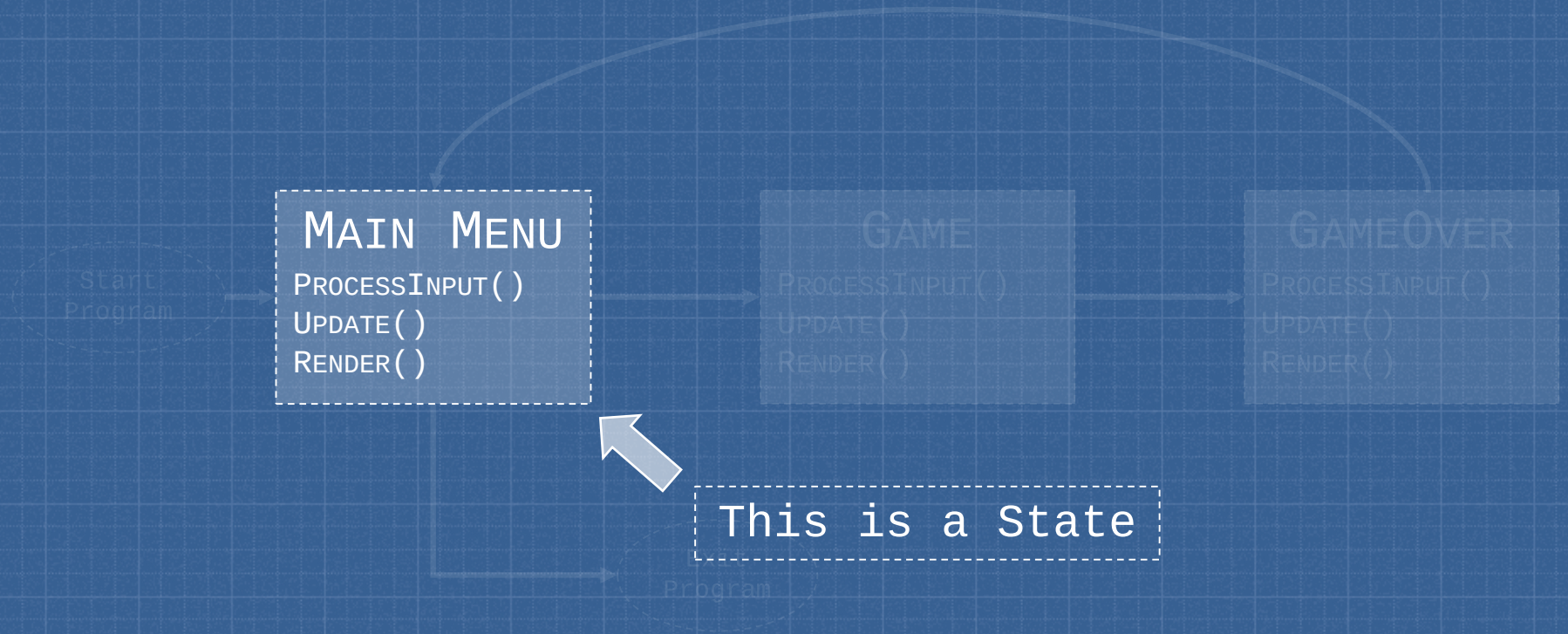
Flowchart



Flowchart


Start Program
Main Menu
ProcessInput()
Update()
Render()
Game
ProcessInput()
Update()
Render()
GameOver
ProcessInput()
Update()
Render()
Exit Program

Flowchart


Start Program
Main Menu
ProcessInput()
Update()
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GameOver
ProcessInput()
Update()
Render()
This is a State
Program

(Very) Simple State Machine

```
typedef enum GameState
{
    State_Default,
    State_MainMenu,
    State_Game,
    State_GameOver
} GameState;

static GameState sCurrentState = State_Default;

void ProcessInput()
{
    switch (sCurrentState)
    {
        case State_MainMenu:
            MainMenu_ProcessInput();
        break;

        case State_Game:
            Game_ProcessInput();
        break;

        case State_GameOver:
            GameOver_ProcessInput();
        break;

        default:
        break;
    }
}
```

- Define state in an Enum
  - Or constants
- Variable to keep current State
  - Change its value to change State
- Switch / case to define what to call

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In the future

- Better ways of doing this:
  - With C function pointers
  - in C++
- Used for many things
  - AI
  - Player behaviour
  - Game Rules

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Thanks!

Any Questions ?

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